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Moulding Bay Baths

A number of foundry concerns have had plans passed by the local authorities for the extension of buildings to provide washing facilities for the employees. We deem such measures to be entirely inadequate: modern social requirements demand nothing less than proper bathing accommodation.

Discussing this matter with the manager of a large foundry situated in a rural area, we learnt that he had ascertained the reactions of the moulders towards the idea of taking a bath before leaving the works. The objections raised were twofold:—(1) The men lived quite close to the works; and (2) there would be a liability to catch cold. Our answer to the first objection is that it is to be associated with selfishness and laziness. It is obviously a selfish action unnecessarily to take workshop dirt into one's home, as its removal normally devolves upon somebody else. Bathing entails a little more effort and time than just the washing of hands and face. As for the second objection, that of taking cold, this is sheer nonsense, as sweat-soaked underclothes are very prone to initiate a chill, as every fast bowler will testify. Unless we have misread articles dealing with this subject, the foundry workers of South Africa must be furnished with adequate bathing facilities, the natives having separate accommodation. Surely this country cannot lag behind the social amenities legalised by the Dominions.

Personal experience has shown us that a higher standard of personal cleanliness is observed by the ex-Service man than by his industrial counterpart. The post-war world will be largely made up of ex-Service men and women, who will desire better standards for observing personal cleanliness both at the works and at home. Competent foundry executives have stated that a primary drawback to recruitment for the foundry industry is the objection raised by mothers to the dirt brought into the house by those employed in foundries. Hence the general provision of baths would overcome a major obstacle to the future welfare of the industry. The case for the provision of bathing facilities is more urgent in urban than in rural communities, as journeys from the works to home are often long and increase the liability of the sweat-daubed worker to catch cold, especially in summer. Moreover, the population has a right to insist that its public vehicles are kept as clean as possible.

It is obvious that the Factory Department was thinking around this subject in pre-war days, for it secured powers for the compulsory provision of drying facilities for workers' clothes. It is a matter for regret that the trade unions have so far failed to interest themselves in working conditions, except in so far as wages and hours are concerned. It has invariably been left to the enlightened employer to initiate ameliorative schemes as a prelude to Factory Department legislation. This applies to the question of foundry baths; for several years they have been provided by at least one go-ahead concern. The latest report we had was that they were regularly used by all the foundry workers except some of the elderly ones. In their case, prejudice was too strong. At the establishment we have in mind the manager was insistent that austerity should be eliminated as much as possible, as the latest materials and designs had every appearance of showing the lowest maintenance costs. In this particular concern, the lavatory accommodation for the factory girls was in every way comparable with that in a West End hotel. The welfare activities are equally well conducted. Yet the firm possesses an enviable financial history. We would like to see the foundry industry earn for itself a name as being the most enlightened in the country. Social enlightenment does pay dividends, as readers of the financial Press will have observed.

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FORTHCOMING EVENTS

FEBRUARY 9.

Manchester Association of Engineers:—"Batch Production and Its Effect on Choice of Manufacturing Plant," by T. P. N. Burness, M.I.P.E. At the Engineers' Club, Albert Square, Manchester, at 6.30 p.m.

FEBRUARY 23.

Keighley Association of Engineers:—"Resistance Welding," by J. Berry, M.Inst.W. At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

MARCH 10.

Keighley Association of Engineers:—Annual dinner, at 5.30 p.m., at which the guest of honour will be Sir Miles Thomas, D.F.C., vice-chairman of the Nuffield Organisation.

Institute of British Foundrymen

FEBRUARY 3.

Lancashire Branch:—"The Immersion Pyrometer in the Cast-iron Foundry," by R. C. Tucker, M.A. At the Engineers' Club, Albert Square, Manchester, at 3 p.m.

FEBRUARY 6.

Burnley Section:—"Gravity Die-Casting," by A. R. Palmer. At the Municipal College, Ormerod Road, Burnley, at 7.30 p.m.

FEBRUARY 9.

Middlesbrough Branch:—"Moulding Sands and Gases in Relation to Casting Defects," by G. W. Nicholls. At the Cleveland Technical Institute, Middlesbrough, at 7.30 p.m.

FEBRUARY 10.

Scottish Branch:—"Some Aspects of Light Alloy Foundry Practice," by M. R. Hinchcliffe. At the Royal Technical College, George Street, Glasgow, at 3 p.m.

West Riding of Yorkshire Branch:—"Aluminium Bronze Alloys: Their Foundry Use and Characteristics," by N. C. Ashton. At the Technical College, Bradford, at 6.30 p.m.

FEBRUARY 17.

Bristol Branch:—"A Study in Moulding and Casting Technique for Small Steel Castings," by E. G. Kelly, O.B.E. At the Grand Hotel, Broad Street, Bristol, at 3 p.m.

Lincoln Section:—"Moulding Sands and Gases in Relation to Casting Defects," by G. W. Nicholls. At the Technical College, Lincoln, at 3 p.m.

FEBRUARY 24.

Birmingham Branch:—"Costs in a Jobbing Foundry," by H. E. E. Holladay, B.Sc. At the James Watt Institute, Great Charles Street, Birmingham, at 2.30 p.m.

East Midlands Branch:—"Some Thoughts on Foundry Management," by J. Roxburgh. At Loughborough College, at 6 p.m.

FEBRUARY 26.

Sheffield Branch:—"The Study of Liquid Metal Temperature and Solidification Range as a Foundry Control by Means of a Thermocouple," by R. C. Tucker, M.A. At the Royal Victoria Hotel, Sheffield, at 7 p.m.

FEBRUARY 28.

London Branch:—"Inoculated Irons," by A. E. McRae Smith, M.A. At the Charing Cross Hotel, London, W.C.2, at 7.30 p.m.

The second issue of the "Standards Review," a new quarterly, just received, is dated September, 1944. It refers to the early interest of the late Mr. H. J. Skelton, who in 1895 complained of the waste and industrial time through meeting the various specifications issued by consulting engineers for steel sections. Since then, we are told, matters have moved quickly. Patterns for colliery hub wheels have been reduced from 3,000 to 25, and hobs for watch gears from 800 to 11. The interest aroused has been well maintained.

BOOK REVIEW

The Heat-Treatment of Steel. By Edwin Gregory, Ph.D., M.Sc., and Eric N. Simons. Published by Sir Isaac Pitman & Sons, Limited, London, W.C.2. Price 18s. net.

This is the third book published under the joint authorship of Dr. Gregory and Mr. Simons, and though much more expensive than the earlier ones, it is still good value for money provided the buyer is really interested in the subject. This phrase becomes necessary, as in recent times, the general public is interesting itself in technical matters to an increasing extent, and a number of suitable books have been forthcoming. The authors have catered for those whose daily task it is to perform heat-treatment operation on steel products—including castings.

Naturally those interested in the heat-treatment of steel castings will study very carefully the information given on quenching and tempering. If they be connected with the American foundry industry, their criticism will be that the warnings given at the bottom of page 213 are unduly restrictive. The percentage of quenched and tempered castings is increasing monthly in the United States, and encouragement should have been given rather than the reverse.

The authors have included five chapters on pyrometers—a somewhat generous allowance—and a like number on the various types of furnaces available. As there are 36 chapters in all, plenty of space has been reserved for the real purpose of the book, and herein can be found information difficult to come by elsewhere. The indexing is quite satisfactory, and better than most.

V. C. F.

INFRA-RED LAMP HEATING

A brochure has just been published by the General Electric Company, Limited, on the subject of infra-red lamp heating. It not only describes in a comprehensive way the developments recently made in this highly efficient form of heat-treatment for many industrial processes, but also illustrates and gives technical particulars of many installations in which infra-red heating has been applied successfully.

Additional information on the contents of the article, "Economy in the Use of Chromic Acid," which appeared in our issue of January 4 last, may be obtained from the Secretary, Electrodeposition Technical Advisory Committee, Armament Research Department, Ministry of Supply, c/o S.T.A.M., Room 1043, Shell Mex House, Strand, London, W.C.2.

"Foundry Practice," the house organ of Foundry Services, Limited, of Long Acre, Nechells, Birmingham, 7, in its November-December, 1944, issue, carries short technical articles dealing with the reclamation of porous castings by the synthetic resin process; the replacement of wrought-iron rods by iron castings, and some notes on high-duty cast iron and the X-ray examination of castings.

PATTERNMAKING*

By W. C. PERRY

Modern patterns require the skill of the finest woodworker

The war has made a great difference in the way the skill of the craftsmen is used, and the change in foundry work is possibly not realised by the engineering trades. The illustrations accompanying this Paper show only a few of the patterns out of thousands a general patternshop is expected to tackle. Much blame must be placed on the foundry because of its inability to cast any thickness or any shape the modern draughtsmen put down on paper in the form of lines, dots and dashes.

Patternmaking dates back beyond most trades to the time when the first article of lead or copper was melted and run on the ground for the use of man. To-day large shops employing from 100 men upwards well equipped with machinery control the output of large foundries and engineering establishments.

To make modern patterns requires the skill of the finest woodworker with a knowledge of other crafts. One must realise that the same patternshop and men are expected, and generally do, supply patterns from the size of a penny—some even smaller such as boot protectors—to those required for castings weighing 100 tons or more for large presses, parts of ships and the like.

Patterns are usually made first in wood. The best wood for most patterns is undoubtedly Pinus-Strobus, or Canadian yellow pine, a nice working softwood. Only seasoned, good-quality timber is used in normal times. In wartime one has to use all kinds of wood for the cheaper grades of work, some which, unfortunately, is not too dry.

The wood should be seasoned first in the open air, but preferably sheltered from rain or snow. It should be piled so that the air can circulate between all boards for about a year. For better-class patterns and hard use, African or Honduras mahogany is used. Straight-grained logs are necessary in order to work the various shapes, and they also keep truer under the changing conditions in the foundry and stores. The Author is still using mahogany for best-class patterns from wood in stock for five or more years, thanks to the help of the Timber Control. The shrinkage ratio of the two woods mentioned being very low, is greatly in their favour, and patterns properly constructed give very little trouble with regard to shrinkage or warping.

The patternmaker is seldom required to make two patterns that are identical. The work, therefore, is very varied and to the solution of new problems are applied the principles gained from previous experience.

[The Author then showed and commented upon a large number of slides, six of which are shown in the accompanying illustrations.]

Tank Tread Patterns

In 1940, at the request of the Ministry of Supply, arrangements were made for the mass production of perfect patterns and coreboxes required on the Valentine, Matilda, Cromwell, Churchill and other tanks in very large numbers. These tank tread castings carried out in manganese steel have been one of the greatest tests ever expected of foundry or patternshops. Since 1940 large new foundries have been built and equipped in districts where the female labour employed had never seen the inside of a foundry. They have produced hundreds of thousands of links—all by means of metal patterns made in one shop to help interchangeability.

Some idea of the quality of casting required must be realised. On no casting is any machining carried out. The castings, when mixed from different foundries or in their own group, must not vary more than ¼ in. in ten or twelve links when linked together—even for big tanks. Castings have to pass very careful examination, and must be 100 per cent. perfect. Owing to the demand, early in 1941, the writer put down a special plant for the production of this type of pattern equipment. This was to ensure the special foundries then being built would not be held up for interchangeable aluminium and cast-iron layout and the hundreds of metal coreboxes needed by the Ministry of Supply for fighting vehicles.

At that time, machine tools were hard to obtain, but, thanks to the help of the various firms, the plant was installed. The installation of cutter grinders enabled the shop to work to much greater accuracy. Often cutters must be measured to a contraction rule or coreboxes opened out 5 or 6 thousandths to bring the total length of a track correct or allow pins to be fitted with ease.

Only men who have had several years at wood patternmaking proved capable of taking a lead in this new type of work, and they seemed to use the machines to the very best advantage with little tuition. A certain number of trainees were brought in to file up the castings after machining, using templates made by skilled craftsmen. Men who had worked at a skilled trade, such as joinery and shop-fitting, have turned out much better than those from other sources.

Drawings of the various track links are first examined to see if the design is simple for moulding and casting. Half-size models of proposed layouts are made cheaply in plaster and a few of the foundries to manufacture the links have then to arrange a small conference of foundry experts to discuss them and settle the best layout, runners, size of box part, etc.

* A Paper presented to the Lancashire Branch of the Institute of British Foundrymen, Mr. A. Hopwood presiding.

Patternmaking

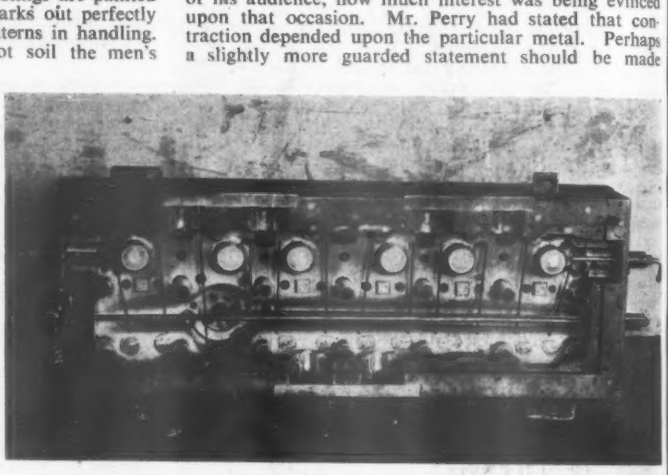
Wood master patterns are then made by the same men, who will see the equipment right through. Aluminium castings from these are then set out and machined wherever possible. The castings are painted with a special printer's ink, which marks out perfectly and does not come off the metal patterns in handling. At the same time, the ink does not soil the men's hands, which is an added advantage. After all parts possible have been through the machine shops, the rest of the work consists of scraping and finishing to accurately made brass or iron templates. This is very tedious work unless good castings are being used. When the dimensions are correct, most of the patterns are fixed in cast-iron frames. The Bren patterns are, however, fitted into steel plates, there being eight on a plate to ensure greater accuracy.

With metal coreboxes, the first consideration for the huge production required must be weight in handling, associated with the making of clean, perfect cores. Aluminium was chosen and for a time all went well; it is light, easy to work, and the men found the change from wood quite easy to overcome. With the introduction of core-blowing machines, the aluminium boxes proved a failure —the life being only a matter of a few days. Cast iron was then tried and used, in spite of the many disadvantages. This is much more expensive to work, even from good castings, and the weight of many boxes slows down production. In some cases aluminium boxes were retained, and the parts showing wear carried inserts of a harder metal—brass or steel. On pin coreboxes the life was much extended by cold-rolled steel, replaceable wearing strips being fixed on the end of the box which contacts the core-blowing nozzle.

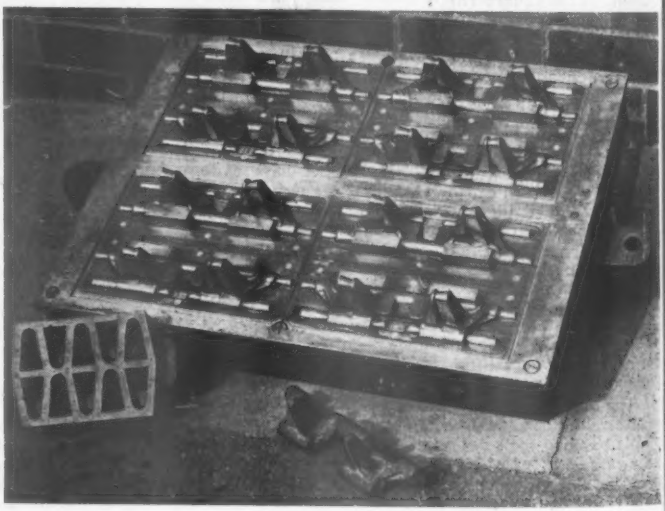
The pitch of all links is so important that it is sometimes found impossible to move the prints the small amount required. The foundry correct this by a slight increase in the bore of the coreboxes, so that the pins give way, say, $\frac{1}{16}$ in. in six or seven links.

Vote of Thanks

MR. A. PHILLIPS (Manchester), in proposing a vote of thanks to Mr. Perry for his Paper, said there did not appear to have been a Paper dealing with that subject read before the Branch for several sessions, and Mr. Perry would be able to realise, from the size of his audience, how much interest was being evinced upon that occasion. Mr. Perry had stated that contraction depended upon the particular metal. Perhaps a slightly more guarded statement should be made



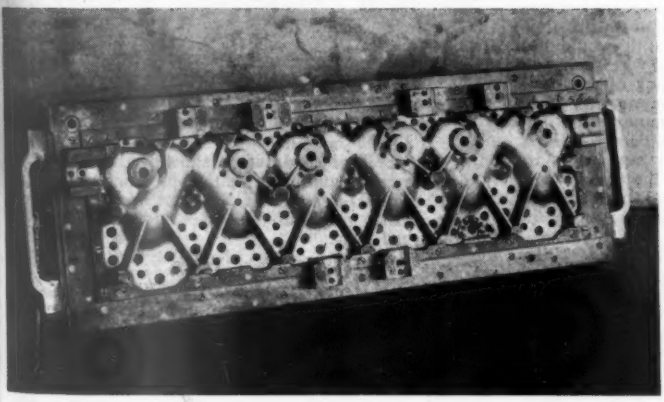
BOTTOM OF COREBOX. (NOTE VENTING ARRANGEMENTS.)



METAL PATTERNS FOR BREN GUN LINK—BOTTOM HALF.

and to state that it depended on the job. It was necessary to look at both sides of the case. Both the patternshop worker and the foundryman, if they had a box to make, invariably wished for a slightly different contraction from what was allowed for the lid of the box, especially if they had to be jig-fitted. A box had a slightly different contraction from the lid. Regard must be had to other points in a similar manner, though perhaps in a patternshop not much notice was taken of them. It was one thing to get a correct pattern, but quite another to get the correct casting, *i.e.*, in the case of two or three castings which had to be fitted together.

PATTERN EQUIPMENT FOR ROAD RIPPER.



MODERN COREBOX SHOWING VENTING ARRANGEMENTS—TOP OF BOX.

Standard Taper and Jigging Points

Had Mr. Perry any experience in regard to metal spraying, *i.e.*, making a wooden pattern and spraying it with metal such as zinc or copper? When a designer made a drawing he invariably produced one which he assumed to be equally suitable for the patternshop, the foundry, and the machine shop, collectively, and did not concern himself with the question of taper. There should be a standard taper; this would eliminate a source of much trouble when going from one foundry to another, or being passed on from one engineer to another.

If Mr. Perry had a drawing given to him, did he go ahead and make the pattern, or did he ascertain where the jigging points were? The jigging points were almost invariably marked off where there was a loose piece or a core. This was a wrong point. Standard taper and jigging points were two items generally missed on jobs owing to patternmakers not attaching sufficient importance to them.

After MR. A. EVANS had seconded, the vote of thanks was carried unanimously by acclamation.

Contraction Allowances

MR. PERRY, in responding, remarked that, as far as contraction was concerned, the firm with which he was associated were working for a very large number of customers spread all over England, though they were mainly in the South, the North catering very largely for itself. There had been found to be contractions at various foundries, records of which were kept at the office and in the checker's room. One foundry would work to 1 in 120 for a cast iron and another to 96, and others to special instructions. Each metal pattern had to be evaluated very carefully. First, in what metal it was going to be made; and they had to make up their minds whether it was going to be an aluminium pattern first or

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aluminium afterwards. It had been found during the course of the year that 1 in 96 was the most perfect contraction for D.T.D. 424, of which most patterns were made. The largest foundry for which his firm worked had different scales of contractions. For a job 1 ft. long, 1 in 120 was used for aluminium, and if the job exceeded 1 ft., an increase was made to 1 in 96.

No difference was made in his own works in the allowance between the lid and the box, and it was only very seldom that any complaint was received, but if it was a mass-production job, it was expected that the job would come back and be put right after the first casting. They did not send a pattern out feeling absolutely certain it would not return. If they were making a switch-cover box and case which had to marry perfectly without machining, they would expect to have to do a little adjustment before turning out an actual production.

Metal Sprayed Patterns

Some 12 months previously his firm had installed a metal-spraying plant. They found they could not get on without it, so it was put in for the metal patterns. With regard to the links which were shown, the patterns were sent out to what was expected to be the correct contraction, but they probably received information that they were coming out a few thousandths under size. Instead of machining a large piece away and adding a lump of aluminium, which was not satisfactory, they used the metal-spraying plant most successfully.

The iron patterns were sprayed with brass, which had sufficiently enlarged the patterns so that they were correct. They had had many patterns which had been damaged built up successfully by this means.

He had not tried metal-spraying wooden patterns, because he had heard that it would not work, and, personally, he was of the opinion that it would not, because the force with which the metal was discharged out of the gun would spoil the accuracy of any well-designed aircraft pattern. It did not appear to be likely that a metal face would be required on any wooden pattern except for large numbers. If large numbers were required, then accuracy was necessary and, by spraying upon wood, possibly the wood would be cut away, while an even surface could not be satisfactorily maintained. He would, however, make the experiment.

Dealing with the question raised by Mr. Phillips concerning the designing of the pattern for the patternmaker, he had been in contact with a large engineering firm employing 2,000 men. They had made an order out in the drawing office to start this idea, but as a patternmaker he objected. During the course of his interview with the directors he told them it would cost hundreds of pounds to their drawing office if they carried out their plan, besides causing endless trouble in the patternshop. At his special request the firm were not now going to draw the patterns out for the patternshop.

They had had a very awkward experience during the war period. They were asked to make a well-known American lathe, and the only drawings they could secure to make the patterns were sent over from America, and were for patternshop use only. They made the patterns and had to add taper, etc. Naturally, a patternmaker robbed metal as well as added metal. Great trouble was experienced in getting the tapers correct and putting the machine allowance right, which would have been better settled by the patternmaker.

METAL PATTERNS FOR BREN GUN LINK.

If he received a drawing showing the machined finish, he could guarantee that in 99 cases out of 100 the job would be successful. It was found, from experience, that they did far better with a drawing of the finished part.

Standard Taper

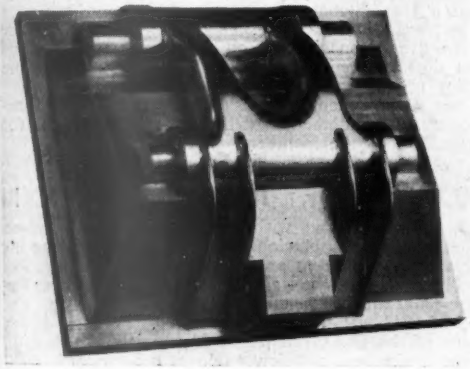
It did not seem possible to establish a standard taper. If he got a large job for a steelfoundry, he put a ½-in. taper in, and it did not matter. But if he got a job for an aircraft firm, there had to be a minimum of taper, so that the job would draw out of the sand. He did not think any draughtsman would be able to include such a taper. About six months ago a very large motor-car firm decided they would draw

out their pattern equipment. Twelve men were drafted into the drawing office to prepare the coreboxes required for a certain motor-car engine. After worrying him for about a week how to draw this and that, he told the draughtsmen they would have to commence their work when the patterns were made. This was the only way that a draughtsman who had not been brought up as a patternmaker could possibly draw the equipment for that particular foundry.

Jigging points were a matter for serious consideration. Jigs were only made when there was a very large quantity required. When recovering the other little bits on the patterns, they generally had to adjust the jigging points. They certainly thought these should be marked on the blue prints.

MR. J. BEDFORD (Bolton) asked whether it was not possible to have trained men who had drawing-office, patternshop and foundry experience and who could form a proper liaison.

MR. PERRY said one motor-car firm gave draughtsmen a short experience in the foundry. In the motor-car trade patterns were standardised to a certain extent, and it was thought that this method would produce beneficial results and that the men would be able to design the pattern equipment for a new foundry. From years of experience he could assure his hearers that draughtsmen could not be expected to pick up the design and shape of a corebox without having had long experience in the patternshop or the foundry, and he did not think that any draughtsman desired to undergo such a course of training.



TYPICAL METAL PATTERN FOR TANK PRODUCTION.

MR. A. EVANS said he was aware of six patternmakers in a drawing office making pattern drawings. These pattern drawings were really necessary because of the patternshop-cum-toolroom state of things. There was so much metalwork involved in patternmaking that it was necessary to bring in a certain number of metalworkers and toolmakers. Therefore, the idea had already been tried out. With regard to the picture of eight patterns of a tank link on one plate, what was the size of the box? Statements had been made that one firm were making 25,000 links a day. It was rather a big box to be handled.

MR. PERRY replied that they were 28-in. by 14-in. boxes, and there were two tops and two bottoms on each of the rotary tables. About eight pattern plates were always in use.

Standard Moulding Methods

MR. T. I. R. FELLING (Manchester) mentioned that the statement had been made that no two foundries wanted identical patterns. Was it not time that British foundrymen laid standard methods of moulding? In his own experience, taking the case of two individual moulders, what would do for one did not suit the other.

MR. PERRY was very pleased the remark had been made, but he was quite sure it was impracticable to lay down a standard method of moulding. In the case of the links, it was found that at one foundry in Scotland they could not make them anything like as good as the way every other link was being cast in England. This was because of local conditions which no one could eliminate. When changed over they made a 100 per cent. job.

Resistance Grids

MR. PHILLIPS referred to the making of grids for the resistance for railway work which could be scrapped on the Ohm-resistance value *plus* or *minus*. In such a case the quantity of metal must be controlled in the initial stage in order to obtain the Ohm-resistance value. It was found, when three men were employed on the work, it was necessary to have three different sets of patterns—one for each of them. One pattern had to be slightly thicker than another and so on, although the difference was only in thousandths. One man handling his pattern rammed slightly harder than another, so that the physique of the men did definitely enter into the matter, and it was one of the points which sometimes cropped up in foundries and created a state of bewilderment at times when it was sought to obtain a good casting. All three men were making the same type of grid, which had to have 0.036 Ohms-resistance value. Even during the course of the day—say in the afternoons—some of the men created a different resistance value in the grids from what they did in the morning.

MR. J. HILL (Heywood) could endorse the statement made by Mr. Phillips. Certain moulders did not strip the pattern very well. There was a definite difference in the wear of each separate pattern over a period of time. It was somewhat remarkable to find that each moulder caused a different wear on the pattern.

Bren-gun Patterns

MR. H. HAYNES (Ashton-under-Lyne) referred to an illustration depicting the changeover patterns as flat. He noticed there was a frame round. When the patterns became damaged, a changeover was required. Did Mr. Perry put the patterns level with the joint low—about a thousandth instead of having a metal

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box joint or a sand joint? Did he so measure patterns, or was there a cast-iron frame round where the screws were put in to keep down the patterns?

MR. PERRY said that, as general patternmakers, his firm made plates in pine, mahogany, cast iron, aluminium, and steel. With reference to the job referred to by Mr. Haynes, which he assumed to be the Bren gun, there were eight loose patterns—jig machined—and each dropped into recess dead level. Although he understood the pattern was put up or down compared with the joint of the plate in some shops, it was not done by his firm.

Dust Accumulation

MR. HAYNES mentioned that sometimes rust accumulated on the box edges to form two halves going together, thus causing too much "thin" in the castings. If that was allowed a thousandth down there would be no "thin."

MR. PERRY remarked that one Midland firm supplied mahogany plates inserted with steel on the corners which stood up $\frac{1}{32}$ in. above the height of the mahogany plate. He was aware of only one firm that did so. Of all the plates his firm had made for tank-track links, every one had had a cast-iron frame, and the aluminium patterns had always been let in exactly level with the cast-iron outer frame. They did try to have the cast-iron frames going right through the job, but much trouble had been experienced, and in the end they had had to have all the plates well-type with bottoms, in order to keep the joint exactly level. At the commencement of the war they made frames with a flange on to take the patterns, but they soon experienced serious trouble, and they had to be scrapped, as every plate had become lapped. In the case of the Bren gun, they actually used $\frac{1}{4}$-in. steel and they were set in about $\frac{1}{2}$ in.

MR. PHILLIPS said it was the difference between a sand joint and a box joint.

MR. PERRY said a point had been raised about the level; in every case they always had it dead level.

MR. PHILLIPS said that if there was sand on the job there was a danger of a man cramping his box.

A MEMBER remarked that there was a crust formed.

MR. LONGDEN said it was a question of how much was allowed.

MR. H. HAYNES said that if the jig pattern had a cast-iron frame, he dropped the patterns in the frame, when he changed them, and allowed a thousandth low down to make a thin joint when it had been pinned. This method had proved to be successful in the change-over of the pattern at less than a minute. Boxes such as the rolled-steel type were thrown about by the labourers and became buckled, but the mould was not buckled even if the boxes were.

MR. PERRY, replying to Mr. Phillips, said that the machine which had been mentioned during the course of the lecture was the Cincinnati hydro-tel vertical milling machine, with a tracer attachment precisely as used in die shops. It had a fairly large range of speeds, but the copying was slow. His firm only used this when the desired result could not be obtained otherwise. Of the other pattern machines, it was found that the Wadkin wood miller was able to do nine-tenths of the very skilled work on metal link patterns.

MR. PHILLIPS inquired whether the firm had a master patternmaking machine.

MR. PERRY replied they had four Wadkin millers.

[A cylinder-head corebox for mass production was then exhibited and explained by the lecturer.]

MR. PERRY stated also that he had brought a very interesting corebox used on the production of pistons. One core was made every six seconds. He was of the opinion that foundry people were willing to spend money in the patternshop. Some of the coreboxes exhibited cost approximately £100 each; they could not be produced for less, and were absolutely interchangeable. The thickness of metal on the pistons exhibited was $1\frac{1}{2}$ mm., and they passed a weight test on a machine to one gramme. The internal shape was not a true diameter, being about $1\frac{1}{2}$ mm. out of a true circle in order to benefit the balance. There were five of such boxes on a blowing machine and the time allowed was between 6 and 10 secs. a core going up the end of the line.

MR. PERRY then gave a demonstration of the functioning of a number of exhibits he had brought for inspection by the members.

IRONFOUNDRY FUEL NEWS—XXXIII

Ironfounders who wish to instal new plant which would result in appreciable savings of fuel will be interested in the recent announcement that a relaxation has been made in the standard under which licences for such plant are being granted. This standard, up to the end of 1944, was that a licence would be granted if the value of the fuel saved within $2\frac{1}{2}$ years of the date of authorisation was sufficient to cover the capital cost of the installation.

In view of the seriousness of the fuel situation, the Ministry of Fuel and Power now announces that the operative period shall be increased from $2\frac{1}{2}$ years to four years. Any schemes which were rejected under the old standard can be reconsidered if fresh application is made to the secretary of the appropriate Regional Fuel Efficiency Committee (Ministry of Fuel and Power).

New ironfoundry plant which may, in individual cases, save enough fuel for a licence to be obtained might include forced-draft equipment for the conversion of existing natural-draft stoves, portable mould driers, weighing machines for cupola charges, shop-heating stoves, or even complete new stoves, cupolas or cupolettes. The Regional Panel of the Ironfounding Industry Fuel Committee will be pleased to advise on any proposed new installation. Addresses of the hon. secretaries of the Regional Panels are obtainable from the Fuel Officer, Ironfounding Industry Fuel Committee, Alvechurch, Birmingham.

EFFECT OF SHRINKAGE AND GAS POROSITY ON THE PRESSURE TIGHTNESS AND MECHANICAL PROPERTIES OF BRONZE SAND CASTINGS

Eliminating wasteful practice of pre-ingotting bronzes made from virgin metals

Mr. W. A. Baker, Mr. F. C. Child and Mr. W. H. Glaisher, the joint authors of this Paper, which was presented to the autumn (1944) meeting of the Institute of Metals, have summarised their extensive researches in the following statement.

The distribution of porosity in bronze sand castings has been studied to determine the relative effects of shrinkage and of dissolved gases on the pressure tightness and strength of bronze castings. The bronzes freeze over a wide range of temperatures, and as a result they do not feed easily and therefore tend to contain widely dispersed small intercrystalline and interdrendritic cavities. This porosity is primarily due to unfed freezing shrinkage, and while its form is very harmful a considerable amount of the porosity is tolerable in a casting from the point of view of pressure tightness, provided that it is uniformly dispersed. However, the porosity tends to concentrate at areas in imperfectly fed castings where solidification has been locally delayed, *e.g.*, at junctions of sections, at bosses, ribs, etc., and such concentrations of porosity cause leakage under pressure and serious local weakness.

The evolution of dissolved gas from bronzes during freezing causes the appearance of larger amounts of similar porosity. The investigation has shown that the presence of gas sometimes reduces the amounts of porosity at local heat centres, but increases the amount of porosity in other parts of the casting, *i.e.*, the gas improves the distribution of the porosity with a resultant improvement in the pressure tightness and strength of imperfectly fed castings, but decreases the strength of fully fed bars. The investigation shows that the distribution of shrinkage porosity in degassed but imperfectly fed castings differs considerably for the various bronzes commercially used for sand castings, and the effect of gas on the distribution of the porosity is also very different in different alloys.

Thus, plain tin bronzes and tin bronzes with low-phosphorus contents (*e.g.*, up to 0.2 per cent.) are particularly prone to local concentrations of shrinkage porosity at points where solidification is delayed. The presence of hydrogen in the melt slightly improves the distribution of porosity, minimising the local concentrations of porosity with some resultant improvement in the properties of unfed castings. Tin bronzes with higher phosphorus contents absorb hydrogen from moisture in sand moulds, and this gas absorption is extremely effective in dispersing local concentrations of porosity. The copper-tin-zinc gunmetals are rather less prone to contain local concentrations of shrinkage porosity, but such concentrations do occur in degassed material with seriously harmful effects. The presence of moderate amounts of gas in the metal causes a substantial improvement in the distribution of the porosity and in the resultant properties of unfed castings, particularly pressure tightness. Larger amounts of gas cause excessive porosity, with resultant deterioration in the pressure tightness and strength.

The leaded gunmetals show very little tendency to contain local concentrations of porosity when the metal is degassed. The presence of even small amounts of gas aggravates the effect of shrinkage in promoting local patches of porosity and has a seriously harmful effect on the properties of both fully and imperfectly fed castings. These various bronzes have very different mechanical strengths when cast into well-fed test-bars. Provided large amounts of gas are not absorbed in the mould, the phosphor-bronzes have the best tensile properties, the copper-tin-zinc alloys are next, and the leaded bronzes have the lowest strengths. In the last alloys the strengths are lower the lower the tin and the higher the lead contents. In imperfectly fed castings, however, the best tensile properties obtainable by control of the gas content as outlined above are of a similar order for all of these types of bronzes, and therefore, from the point of view of pressure tightness and strength of such castings, the merits of the various alloys should be judged from the ease with which the best properties are obtained.

From this point of view, the leaded bronzes are the best alloys for castings of intricate shape which are not easily fed. These alloys give the best properties when the gas content of the melt is very low, and this condition is readily and consistently attained, *e.g.*, by melting under strongly oxidising conditions with or without oxidising fluxes or additions which evolve oxidising and/or scavenging gases. Gassy melts can be quickly degassed by scavenging treatment with nitrogen or air, but the copious evolution of zinc fumes and the attendant metal loss do not commend this as a practical procedure.

Gas Absorption

The high-phosphorus bronzes also give the optimum results in imperfectly fed castings when the melts are degassed before pouring, but in this case the desired uniform distribution of porosity is secured by gas absorption in the mould. This gas absorption is controlled by control of phosphorus content and pouring temperature, *e.g.*, a phosphorus content of 0.3 to 0.5 per cent. and a pouring temperature of 1,130 deg. C.

give a suitable amount of gas absorption. However, the phosphor-bronzes cannot be degassed sufficiently by oxidation treatment and scavenging with air or nitrogen is necessary. In these alloys the scavenging treatment is easily applied and does not suffer the practical disadvantages mentioned above. A charcoal cover on the melt before and during scavenging treatment with air is desirable for two reasons:—(1) It minimises oxidation and loss of phosphorus during melting and prevents the formation of phosphate slags which attack the melting crucible; and (2) its presence on the surface of the melt during air blowing allows the metal to be agitated violently for rapid degassing with lessened risk of drops of metal being blown out of the pot. Moreover, the use of a charcoal cover during degassing improves the pressure tightness of poorly-fed sand castings, for some reason which remains obscure.

The copper-tin-zinc alloys are the least satisfactory of the alloys examined for intricate castings required to be pressure tight. The best properties in imperfectly fed castings are obtained when the metal has a small gas content, low and high gas contents being unsatisfactory. It is not easy to ensure that each melt shall have the desired gas content, although some measure of control is possible by control of the furnace atmosphere and the use of fluxes as previously described. Experience gained in this investigation suggests that each melting furnace would require individual consideration for this purpose, and in this connection density determinations on the D.T.D. test-bar described in this Paper should provide the best guide to the most satisfactory melting conditions.

The research has amply demonstrated the absurdity of judging the mechanical properties of imperfectly fed castings by separately cast, fully fed test-bars. The test-bars give valuable information about the condition of the metal when densities as well as mechanical properties are measured, but the highest densities and mechanical properties do not give the best mechanical properties or pressure tightness in unfed castings of phosphor-bronze and gunmetal. In leaded gunmetals, however, the maximum densities and mechanical properties of the fully fed test-bars coincide with maximum properties of unfed castings.

Practical Recommendations for Sand Casting of Bronzes

A. Design of Casting, Running and Feeding

The main object of the present work was to investigate the effect of gas content in relation to shrinkage unsoundness in different bronzes, and to devise means of controlling the gas content to the degree found necessary to give the best results. At the same time, it is recognised that design of castings and methods of running must also be adequately looked after if serviceable castings are to be produced. The following recommendations refer mainly to control of metal condition, but some introductory observations are offered on the design and running of castings that do no more than touch on the main principles which must be followed.

Practical experience and the present investigation show that local heat centres at junctions of sections, bosses, etc., are potential sources of difficulty, and their effects should be alleviated as far as possible by co-operation between the designer and foundryman. In this connection it should be noted that thin sand walls or small cores separating two metal sections in close proximity may easily become overheated, and may have the same effect as a change of section in delaying solidification in local parts.

Methods of running and feeding will vary with every individual casting, but in general the method of running should be such that the metal which first enters the mould flows to those parts of the casting remote from the feeders, while the feeders should be filled last with hot metal. In many cases this may be achieved by pouring direct into feeders without serious risk of dross inclusions in the casting. The use of pouring basins with strainer cores will retain dross from the pouring crucible or ladle. In many cases it may be impractical to pour direct into feeders, but it may be possible to arrange ingates to enter the casting at or near the junctions between feeders and the casting. This procedure will ensure that the overall temperature gradients in the casting are in the required direction, *i.e.*, high temperature in parts of the casting near the feeders and low temperature in parts furthest from the feeders.

Attention to the above general points will ensure that the conditions of solidification are as favourable as possible to the overall soundness of the casting, but any local heat centres remaining in the casting are potential sources of locally defective areas, where the casting may leak and be mechanically weak. The present work indicates that these defects in poorly fed parts of a casting may be largely avoided by control of the gas content of bronze melts, and the following recommendations are made to this end.

B. Control of Metal Condition

Phosphor-bronze. Up to 10 *per cent. tin and* 1 *per cent. phosphorus.*—Reduce the gas content of the melt to a minimum by one of the following procedures:—(*a*) Melt virgin metal or scrap containing not more than 0.05 per cent. phosphorus under oxidising conditions, with or without oxidising fluxes. Skim off fluxes, etc., before adding the final phosphorus content required (allowing for 0.05 per cent. phosphorus loss in deoxidation) a few minutes before pouring, and (*b*) melt virgin metal and/or phosphorus-containing scrap under a charcoal cover and degas by blowing a rapid stream of dry air through the melt at a rate which will agitate the melt as violently as possible. Use a cover on the crucible during blowing. A phosphorus loss of the order of 0.05 per cent. will occur in melting and blowing. The air should preferably be taken from cylinders containing air at not less than 20 atmospheres pressure, when no drying equipment will be required. Drying equipment may be necessary if the air is taken from air lines ordinarily available in foundries.

To obtain maximum mechanical properties in fully-fed castings or test-bars.—Keep the pouring temperature and phosphorus content as low as possible. Tensile properties of the order of 21 tons per sq. in. and 30 to 40 per cent. elongation are obtainable in D.T.D. test-bars from alloys containing up to 0.3 per cent. phosphorus.

To obtain maximum pressure tightness and best mechanical properties in poorly-fed castings.—Adjust the phosphorus content and/or the pouring temperature until the density of a fully-fed D.T.D. test-bar lies between 8.5 and 8.7 grm. per c.c. and the ultimate strength lies between 16 and 18 tons per sq. in. With a phosphorus content of 0.3 per cent. a pouring temperature of 1,130 and 1,180 deg. C. will be required to produce this result, but with an increase in phosphorus content the pouring temperature may be lowered to produce this result, but with an increase in phosphorus content the pouring temperature may be lowered. Tensile strengths of the order of 12 tons per sq. in. may be expected in the weakest parts of poorly-fed castings.

Lead-free Gunmetals, e.g., 88:10:2 and 88:8:4

To obtain maximum mechanical properties in fully-fed castings or test-bars.—Melt to give minimum gas content by one of the following procedures:—(*a*) Virgin metal charges: melt copper under an oxidising flame, with an oxidising flux if necessary. Skim off flux if used, add zinc (allowing 0.25 per cent. zinc for loss), add tin, and finally 0.03 per cent. phosphorus, and (*b*) ingot metal and scrap charges: charge 2 per cent. manganese ore at the bottom of the crucible or on to the hearth of reverberatory furnaces, followed by ingots and scrap. Melt under oxidising conditions. deoxidise with 0.03 per cent. phosphorus.

Procedure (*b*) will be less effective than (*a*), but in general all virgin metal charges are not likely to be used very often and procedure (*b*) must be used. Where mixed virgin and scrap charges are melted, procedure (*a*) may be used if the amount of scrap is small, less than 10 per cent. of the whole; but procedure (*b*) will generally be necessary, in which case only virgin copper should be charged with scrap, and tin and zinc additions made before final deoxidation.

Zinc loss using procedure (*b*) will be of the order of 0.5 per cent., and an addition of this order will be required to maintain the correct composition. The recommended additions of phosphor-copper for deoxidation are intended to ensure a residual phosphorus content of 0.01 to 0.02 per cent., and check analyses should be made to see that this result is attained. Pour in the temperature range 1,100 to 1,200 deg. C., depending on the section and design of the casting. Tensile strengths of the order of 19 tons per sq. in. and 40 per cent. elongation are obtainable in D.T.D. test-bars.

To obtain maximum pressure tightness and best mechanical properties in poorly-fed castings.—Melt to give a small gas content, *e.g.*, (*a*) by melting ingot under slightly oxidising or neutral conditions, followed by deoxidation with 0.03 per cent. phosphorus before pouring, or (*b*) by charging 2 per cent. manganese ore at the bottom of the crucible and melting under reducing conditions, dexodising as before. The best gas content is difficult to obtain consistently, but the densities of fully-fed D.T.D. test-bars should be in the range 8.65 to 8.75 grm. per c.c., and tensile strengths should be between 15½ and 18½ tons per sq. in. Pour in the range 1,100 to 1,200 deg. C. Strengths of the order of 10 to 11 tons per sq. in. may be expected in the weakest parts of poorly-fed castings. Lead-free gunmetals are not generally recommended for pressure castings whose shape makes feeding difficult.

Leaded Gunmetals

To obtain maximum pressure tightness and strength in fully- or poorly-fed castings.—Melt to give the lowest possible gas content, *e.g.*:—(*a*) Melt virgin copper under strongly oxidising conditions, if necessary using an oxidising flux, add the zinc (allowing 0.25 per cent. zinc for loss), add tin and lead, and finally deoxidise with 0.03 per cent. phosphorus, or (*b*) charge 2 per cent. manganese ore at the bottom of the crucible or on the hearth of reverberatory furnaces, charge ingot material (including copper ingots if any virgin metal is used) and scrap, melt and add zinc, tin, or lead required to maintain the correct composition, and finally deoxidise with 0.03 per cent. phosphorus. Zinc loss in melting will be of the order of 0.5 per cent. zinc. The residual phosphorus content should be of the order of 0.01 to 0.02 per cent. Pour in the range 1,100 to 1,200 deg. C. Fully-fed D.T.D. test-bars should have strengths of the order of 17 tons per sq. in. and 14 tons per sq. in. for 86:7:5:2 and 85:5:5:5 gunmetals, respectively. Strengths of the order of 10-11 tons per sq. in. may be expected in the weakest parts of poorly-fed castings.

C. General Recommendations on Choice of Alloy

Leaded gunmetals are strongly recommended for intricate castings required to be pressure tight. The strength attained in the weakest parts of the castings will be approximately equal to that in similar castings of the stronger phosphor-bronzes or lead-free gunmetals, although the strength of well-fed parts of the castings will be lower than that obtainable in the stronger alloys.

D. Pre-Ingotting of Virgin Gunmetal Melts

The practice of pre-ingotting bronzes made from virgin metals should be quite unnecessary if the above recommendations are followed, and this wasteful practice is strongly deprecated.

"The Enamellist," quoting from American Government sources, gives the following percentage figures of domestic appliances which are now out of order:—Electric toasters, 7; electric irons, 6; electric fans, 7; house radios, 15; vacuum cleaners, 7; sewing machines, 5; refrigerators, 2; washing machines, 5; gas cookers and electric cookers, 3 per cent.

The Automobile Research Committee is undertaking a large scale investigation into the behaviour of cast-iron crank shafts.

STRENGTHENING TIMBER

IN PATTERNS AND COREBOXES

By "CHECKER"

The patternmaker is often faced with the problem of making a pattern, or part of a pattern or corebox, which requires some support to strengthen the timber in such a way that it will help to eliminate twisting, warping, or shrinkage. When battens or stopping-off pieces can be screwed on to the surface of the wood, the problem is not so difficult, but when this is not practical, other means have to be used.

Fig. 1 shows the tongue and groove method of holding the joints of the timber together. This is accomplished by adjusting the circular saw to the required height above the saw table, and running the edges of the wood over. This puts the groove in the timber, and the tongue is made to slide in.

If the timber is shaped in such a manner that much of the strength is cut away, as shown in Fig. 2, which is a loose top part of a corebox with battens for rapping at the ends, and where delicate sections are left between the holes, these can be reinforced by drilling holes for wood dowelling, and glueing and knocking it in. The position is shown by the dotted lines in Fig. 2. If necessary, the dowelling could be taken right through the width of the timber, and it is preferable to put the dowelling in before cutting the holes out, as it eliminates the risk of breaking across the weak sections, and also the dowels may twist the wood slightly; if this should happen, it can then be planed true before finally marking out for cutting.

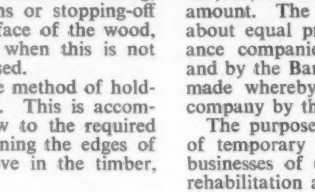

FIG.1

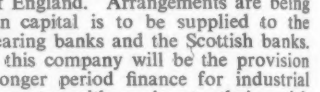

FIG.2

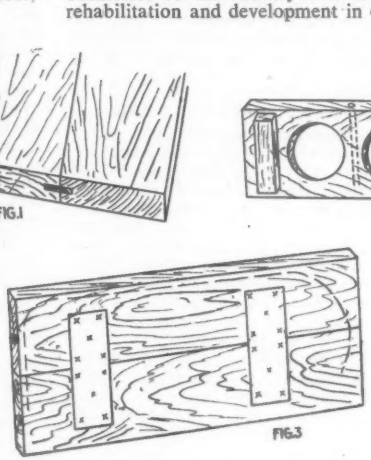

FIG.3

Fig. 3 shows the two pieces of timber required for making a large flange for a pattern. The difficulty where the flange is wide is to stop the shrinkage in the overall width. This can be overcome to a large degree by sinking battens into the flange approximately half the depth and planing level to the flange thickness, also shown in Fig. 3. Make sure that the battens are a good fit, screw them into position, but do not glue any of the joints. The battens should be as long as possible and, when the wood shrinks, the centre joint will open, as the battens will not allow the outside to shrink inwards. This is especially important when bosses are positioned on the outside shape of the flange.

The Ministry of Information has, at the request of the Ministry of Fuel and Power, prepared a short film bearing the title "Steam." It deals with the efficient use of steam in industry, and demonstrates common sources of waste involving consequent waste of fuel.

FINANCE FOR INDUSTRY

Discussions have been taking place among the banking and financial communities of the country on the financial needs of industry in the post-war period. As a result, it is proposed to set up two companies. One company, to be named the Finance Corporation for Industry, Limited, is intended to have a capital of £25,000,000 and borrowing powers of four times that amount. The capital is to be subscribed roughly in about equal proportions by consortiums of the insurance companies and the investment trust companies and by the Bank of England. Arrangements are being made whereby loan capital is to be supplied to the company by the clearing banks and the Scottish banks.

The purposes of this company will be the provision of temporary or longer period finance for industrial businesses of the country with a view to their quick rehabilitation and development in the national interest, thereby assisting in the maintenance and increase of employment. The company's primary purpose will be to provide finance and not itself to reorganise industry.

The second and smaller company, to be named the Industrial & Commercial Finance Corporation, Limited, will have a capital of £15,000,000 and borrowing powers of twice that amount. The capital will be subscribed by the clearing and Scottish banks, together with a token subscription by the Bank of England, and it is being arranged that the loan capital will be available from these banks in the same proportions as they subscribe for the shares of the company. The total resources of the company will therefore be £45,000,000, and the object will be to supply medium and long-term capital for small- and medium-sized businesses of the country in amounts, say, from £5,000 to £200,000.

On the petition of the Treasury Solicitor, Mr. Justice Vaisey, in the Chancery Division, on January 22, made an order for the winding up of the Itabira Iron Ore Company, Limited.

THE MAKING OF HIGH-DUTY IRON CASTINGS TO SPECIFICATION*

The development of ironfounding has demanded new properties in cast iron

By E. HUNTER

When the Author was asked to present this Paper, he felt that two questions were involved. First, what is the ironfounder's attitude towards specifications? and, secondly, how does the industry tackle this problem?

To the first question the answer is, the modern ironfoundry prefers to work to specification. This may surprise those people who are not familiar with the progress which has taken place in the last ten years, but a brief survey of this progress will show that, while the cast-iron industry has not had the publicity that many of the other industries have enjoyed, its progress and achievements, though not spectacular to the layman, have earned it much respect and admiration from the industrial world.

At one time, cast iron was limited very largely to such components or units as ironmonger's hardware, gas cookers, plumbers' ware and artistic ornaments. The development of the internal combustion engine, the Diesel engine and the electrical industry created a large potential market for cast iron. The intricate design of the components called for a metal which would readily cast and the service requirements necessitated freedom from porosity. The development of the aeroplane, the mass production of motor-cars, refrigerators, machine tools, etc., all created demands for a cast iron which possessed increased physical and mechanical properties.

New Properties Demanded

To meet all the new demands, cast iron has to possess such qualities as high strength, resistance to fatigue and impact, resistance to heat, corrosion, erosion, abrasion, be pressure tight, and uniform in all sections. It is obvious that no one metal could possess all these qualities unless that metal could be melted by some process which would enable the ironfounder to control the physical structure and vary it according to the function which the casting must fulfil.

Recent Progress

It will be appreciated that ironfounding has progressed far beyond the conception of some of its critics who were wont to describe that art of ironfounding as "the making of a hole in sand into which was poured molten metal." Even so, until 1938, the only general engineering specification for cast iron was B.S.S. 321, which was first published in 1928. The maximum tensile strength called for by this specification was 12 tons per sq. in. There were existing B.S.S. Specifications for a few specific applications such as piston rings, automobile cylinders, and so on, but it was not until 1938, when the British Standards Institute published B.S. 786, that the industry acknowledged the existence of cast iron with increased physical and mechanical properties. This did not mean that such irons did not exist; on the contrary, the cast-iron industry, by intensive research investigation, as already shown, had made a great number of developments; so much so, that the physical properties of processed cast irons were so much in advance of this Specification that in 1941 the British Standards Institute published an addendum to B.S.S. 786.

The figures published are not the optimum results that can be obtained. Tensile strength of up to 35 tons per sq. in. can be obtained by quenching from 870 deg. C. into oil and giving a suitable tempering. Thus it will be seen that the term cast iron no longer means a cheap but unreliable commodity suitable for only those components or units which do not call for special properties. High-duty irons are processed to give those physical and mechanical properties necessary for individual service requirements. There is now a wide range of irons from which to choose the metal most suitable for a particular duty.

A Handling Problem

The foundry with which the Author is most familiar handles approximately 1,000 patterns per week, from which may be required any quantity of castings from one to many thousands. The service duties required are as complex as the variety, and in order to meet all requirements it is necessary to melt from ten to twelve processes daily.

A description of some of the applications of cast iron given later, show examples of some of the requirements which the modern ironfounder has to meet, such as:—Dimensional accuracy; resistance to pressure; abrasion; corrosion; erosion; heat; high impact and fatigue values, and high tensile, transverse and compressive strength. In addition the casting must be clean, sound and free from imperfections, and, except in the case of those castings to resist abrasion, must be easily machinable.

Organisation of Control

In a large organisation the technical control is subdivided into five sections, which are as follow:—(1) Laboratory; (2) metallurgical processes; (3) pattern and equipment inspection; (4) quality control, and (5) final inspection.

In order to see the full effect of technical control and to understand why it is necessary to sub-divide

* Extracted from a Paper read before the Wolverhampton Branch of the Institution of Engineering Inspection.

High-duty Iron Castings

the control into sections, it would be propitious to follow the process of a piece of pig-iron until it leaves the foundry, as a casting, clean and accurate in dimensions and conforming to the necessary specification.

Raw materials such as pig-iron, steel, coke, sands and so on, are bought to specification, and the laboratory is responsible for testing all incoming raw materials and releasing them to the foundry. When the raw materials have been accepted it is the responsibility of the metallurgical process control to see that they are used correctly.

This department supervises all melting units, methods of charging and melting, and must see that the casting is made to the required metallurgical specification. Control of metal is very rigid, all charges are carefully weighed and are charged on to the furnace to a pre-arranged system. Each tap of metal is tested before it leaves the furnace, thus assuring that the metal composition is correct and a complete record is made of all relevant data. Sand is controlled by this department, tests are made at regular intervals on both natural bonded and oil bonded sands.

The selection of the correct mix of sand for any individual job is one of the functions of the quality control, but more will be said when this department is discussed. This method of moulding is dependent on several factors, the size and shape of the casting, the quantity required, the service which the casting must fulfil, the process of iron in which the casting is to be made, and the dimensional accuracy required.

When the quantity of castings required is sufficient to justify the cost, metal patterns and special moulding equipment are made. The moulds are then made on machines which eliminates much of the fatigue of moulding. The use of metal patterns enables the foundry to work to very close dimensional accuracy, and it is not unusual for castings to be produced to an accuracy of $\pm$ 0.010 in.

Operation of Control

Before a pattern is handed to the moulding department it is first examined by the pattern and equipment inspection department, who make sure that it is in good condition and dimensionally correct. With the co-operation of the quality department the running and feeding system is designed. The moulding equipment, boxes, moulding boards, and so on, are then checked, so that as far as humanly possible the moulder is handed patterns and equipment which are capable of producing a casting correct to dimensions.

The method of moulding and the gating technique for an iron of, say, 25 tons per sq. in. tensile, is very different from that used for a phosphoric iron. This is due to four factors, the melting point of a low carbon, low-phosphorus iron is higher, the rate of solidification is higher, the liquid shrinkage is higher and the fluidity is lower.

The casting having been made is delivered to the shot-blasting department, and from there to the final inspection. Here the casting is inspected for external faults and dimensional accuracy. Rejected castings are passed to the quality department for investigation, thus assuring that no fault may develop which might cause a high proportion of rejects.

The quality department have full authority to stop any job or to make alterations to patterns, or equipment, if they are not satisfied that the particular job is being made efficiently or if the quality of the casting is not to the required standards. If the final inspection department are satisfied that the casting is correct, it is despatched to the customer, but this to the foundry is not the end of the story. The user has to machine and probably submit the casting to further tests; defects which show up are the responsibility of the foundry and must be replaced. After this stage the casting may have to be heat-treated to give a higher tensile strength, or increased hardness, and finally the casting has to be put into service. Whilst failure in service is not regarded as the liability of the iron-founders, no manufacturer of high-duty castings could continue in business for long if failure overclouded successes. The quotation from Mark Anthony's oration: "The evil that men do lives after them," is as true to-day of those of us who have to please the consumer as it was in the days of the Roman Empire. If anyone should doubt this the Author commends them to attempt to console a machine-shop superintendent who has broken his last milling cutter on a hard casting.

Careful records are kept at every phase in the production of castings, the object of the system being to maintain a high standard of quality. The efforts of the technical sections could not have their full effect unless the central control was live and efficient.

Object of Technical Control

Technical control calls for more than the ability to reject or pass a certain component. It requires the ability and knowledge necessary to organise and control each process so that the resultant product will meet the required specification. To ensure that quality is maintained it is first necessary to determine the standards to which the product must comply. For commercial purposes the standard quality must be based not on a fixed value, but on a range of values bounding a central value. In other words, a certain tolerance must be allowed. It is obvious that this tolerance must be as narrow as possible in order that the product will be consistently uniform.

The quality control charts are thus plotted with three lines, the centre line is the positive standard required, the two outer lines being the upper and lower limits.

The results of chemical and mechanical tests and other statistics are plotted on these charts. The statistics are plotted as single results and as averages. The single results show up any peaks and depressions due to inconsistency, the averaged results are used as a guide to future policy. From a chart not reproduced it was shown that by using average results it is possible to give on a single chart, figures

for at least 12 months, so that any general deviation from the central fixed standard can be noticed immediately, and should any variation occur either by deterioration of raw materials or a decline in workmanship, the necessary steps can then be taken to correct or remove the cause.

By these means technical control ensures that the products of the foundry adhere to certain standards. These standards are usually based on agreed engineering standards such as the British Standards Specifications, the standards of certain patents or on established scientific discoveries.

It is in the interest of the user that the foundry should be consulted before a specification is decided upon, as often the foundry technician, who is a specialist in castings, is able to make recommendations which considerably enhance the service of the castings. Happily, designers and engineers of to-day are taking more advantage of the foundryman's experience than was the habit a few years ago. The result of this co-operation is clearly shown in improved casting design and performance.

Specifications for castings are not limited to physical standards. It is common practice for castings to be made to an accuracy which a few years ago was considered an impossibility. Consideration of the type of castings now being made in processed cast iron will remove any doubt that this metal can be controlled to give consistently enhanced physical properties, a high standard of quality, precision and accuracy.

Modern Applications

Conclusive evidence is found in the number of applications in which processed irons have replaced alloy steels. The cast crankshaft is one of the many examples of the application of a cast metal for highly-stressed components. Recently a compressor fitted with a cast crankshaft seized; when the compressor was dismantled, it was found that the connecting rod had broken, and the key which holds the flywheel to the crankshaft had sheared; the crankshaft was undamaged.

The cast crankshaft shows a considerable saving in cost over forged crankshafts, the cost of patterns being but a fraction of the cost of a set of forging dies; any alterations in design can be carried out quickly and at little cost, whereas with a forging alterations in design usually mean a complete new set of forging dies and also a considerable hold-up in production while the new dies are being made.

Many engineers have reason to be grateful for the accuracy with which high-duty iron can be cast. Dies for forming, drawing, planishing and hot pressing can be cast to shape. Thus, instead of machining from a block of steel, a die is produced with a profile accuracy which requires only a hand operation before being put into operation. Saving in tool-room man-hours of up to 75 per cent. can be effected, with a corresponding saving in the time required to make the dies. The casting of dies and punches to this accuracy calls for a new technique in moulding practice. The dies were cast to an accuracy which resulted in the only machining necessary being to grind the base flat and clean up on the angles.

An Example of Accuracy

The cams used in the manufacture of matches were originally made in Sweden, in a Swedish iron with steel inserts; the life of a cam was three months. A cam made in a processed cast iron, after two years, was removed because this type of cam was obsolete; there was no sign of wear whatever on the cam. These cams operate in pairs, revolving at 42 r.p.m., a hardened steel roller running in the cam tracks. The load on the two cams is 3 cwts. As an example of the accuracy to which the modern foundry can work, no better example could be given than the castings for a flexible coupling. This casting is made to an accuracy of $\pm$ 0.005 in., and every casting is gauged before acceptance.

With a yearly production of some 8,000,000 castings, which is equal to 10,000 tons, made from approximately 50,000 different patterns, the reject for all causes from the user was 0.6 per cent. This surely is the answer to any criticism either of the product or of the necessity for quality control.

In conclusion, the Author wishes to thank John Harper & Company, Limited, and John Harper (Meehanite), Limited, for permission to read this Paper and to draw upon experience gained in their service, and to acknowledge the help of his colleagues.

HIGH-SILICON ACID-RESISTING IRONS

In a further note on the "Microstructure of High-Silicon Acid-Resisting Iron" to the Iron and Steel Institute, Dr. J. E. Hurst, in association with Dr. R. V. Riley, both of Bradley & Foster, Limited, Darlaston, have summarised their conditions in the following statement:

Further observations on the nature of the "barley-shell" structure (see "Journal of the Iron and Steel Institute," 1944, No. I, pp. 221 P-224 P) are recorded. The well-defined barley-shell structure observed by W. Wrazej ("Journal of the Iron and Steel Institute," 1944, No. I, pp. 227 P-236 P) on pure (electrolytic) iron and steel, was found to be produced only when the etchants containing hydrofluoric acid were contaminated with silica or silicon-bearing compounds. The dissolved silica in the etchant could be derived from a number of sources, as, for example, the glass vessel in which the reagent had been stored or from a specimen of high-silicon iron alloy previously etched in the same etchant. The barley-shell structure was invariably produced on high-silicon iron alloys even when the etchant was free from silica. The fact that silicon or its compounds, either in the etching reagent or in the specimen, are essential to the formation of the barley-shell structure will have to be taken into consideration in any explanation of its exact nature.

SOUTH AFRICAN IRON AND STEEL

WAR AND POST-WAR DEVELOPMENTS

During the war years Iscor had produced special purpose steels to over a hundred different specifications, said Dr. H. J. van der Bijl, the chairman, at the annual meeting of the South African Iron & Steel Industrial Corporation, Limited, held in Pretoria towards the end of last year. To do this in a works which had been designed and equipped for the mass production of ordinary commercial steels was no mean achievement, he added. The production of special steels inevitably displaced a much greater tonnage of commercial steels, so that Iscor's total output was reduced to that extent.

Throughout the war period, construction work had been in progress in connection with plant extension schemes designed to increase Iscor's total output and to extend the range of steel products produced. The first of these extension schemes had been decided upon, and had been put in hand, just prior to the outbreak of war, comprising converted plant to operate in conjunction with the open-hearth furnaces on the "Duplex" process and also a second battery of coke ovens. The progress of this work was seriously delayed due to the war and, before it was completed, a second and much larger extension scheme was embarked upon, as a war measure. This latter scheme had the support not only of the Government authorities in South Africa, but also of the Government authorities in the United Kingdom and the U.S.A., where high priority was awarded to the manufacture and shipment of the plant. The scheme embraced, *inter alia*, additions to the mining plant and equipment, a third blast furnace, extensions to the steel melting department, and extensive additions to the rolling mill equipment, including a large cogging mill and a plate mill, the latter being erected at the new steelworks' site, known as Vanderbijl Park, in the Vereeniging district; and was designed to bring Iscor's steel production up to about 600,000 ingot tons per annum, and to provide for the conversion of this output into steel products.

Output Figures

Annual steel production (*i.e.*, ingot production plus molten steel diverted to the manufacture of bombs) during the last four years had been:—Year ended June 30, 1941, 316,991 tons; 1941-1942, 326,154 tons; 1942-1943, 377,300 tons; 1943-1944, 466,216 tons. They were a good deal later than had originally been anticipated in obtaining the full increase in output from the extension programme, due partly to their having experienced a considerable increase in the silica content of some of their raw materials, and partly to some of the plant and equipment from overseas arriving much later than was expected. It was only recently that certain essential items of equipment from overseas reached the works (including the replacement of equipment lost at sea by enemy action in 1943).

Dr. van der Bijl went on to say that with the progress of the war during the past year, consideration was being given to plans for post-war development. The consumption of steel in South Africa had all along been much in excess of local production, he said; and, although a large percentage of the present consumption was for war purposes, which would fall away in due course, there was a considerable backlog of unsatisfied demand which would have to be met when restrictions on the availability and use of steel were removed. There was also evidence of much prospective mining and industrial development in the Union which would, in turn, create additional demands for steel products in various forms. The directors intended to proceed with appropriate extensions of plant in the post-war period and to expand Iscor's output of steel products in step with the industrial development of the country as a whole. These extensions would take place mainly at their new steelworks site at Vanderbijl Park, where sufficient land and rights to water had been acquired to take care of developments for many years to come. At Vanderbijl Park, land was also being earmarked for other industries that might find it desirable to locate themselves there.

WORKS CLOSED FOR STOCK-TAKING

The question of a firm's liability to pay wages to workmen when their factory was closed for stock-taking, came before Coventry County Court recently, when Leonard C. Weighman sued Riley (Coventry), Limited, for alleged breach of contract under the Essential Work Order, claiming £1 13s., wages for Saturday and Monday, when the defendants' premises were open only for the purpose of stock-taking, and the only persons admitted were those engaged on that task.

Judge Forbes said he had come to the conclusion that defendants had established a practice at their works to close at approximately regular intervals and periods for the purpose of stock-taking, and workers at their factory were employed on the understanding that this practice would be followed and no wages be paid in respect of stock-taking periods except to those who were stock-taking. Therefore, he awarded judgment for defendants, with costs.

IT IS OFFICIALLY announced that the Governments of the United States, Great Britain and Canada have decided to maintain the Combined Production and Resources Board and the Combined Raw Materials Board until the end of the Japanese war. It is felt that there will be a large field of usefulness for these Boards for the rest of the war even though many materials and products may be in easier supply as the war progresses.

MR. N. MASON, managing director of Mason & Burns, Limited, malleable ironfounders, Walsall, has written to a member of the Birmingham Stock Exchange:—"We understand that certain rumours are in circulation that this company is likely to be taken over by another concern. There is absolutely no truth in these rumours." Mr. Mason adds that the results for the current year are very unlikely to show any improvement upon those of last year.

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NEWS IN BRIEF

AT JANUARY 1 the official cost-of-living index figure was 102 points above the level of July, 1914, as compared with 101 points at December 1. For food alone the index figure remained unchanged at 68 points above the level of July, 1914.

AN EXHIBITION CALLED "Wealth from Waste" has been opened by the Salvage Department of the Ministry of Supply at the Carlton Hotel, London. The main exhibits relate to recovered oil, foundry materials, scrap metals, cloth, rubber and new uses for sawdust.

THE FIRST MEETING of the current session of the London Local Section of the Institute of Metals will be held on February 8 at 4, Grosvenor Gardens, London, S.W.1, at 6.30 p.m. Mr. G. L. Bailey, M.Sc., the chairman, will deliver his inaugural address, entitled "High Priority Metals in Industry."

WALMSLEYS (BURY), LIMITED, have entered into a manufacturing agreement with Craven Bros. (Manchester), Limited, under which the latter will substantially assist Walmsleys in the manufacture of their products Walmsleys (Bury), Limited, and their associated company, Bentley & Jackson, Limited, manufacture pulp and paper-making machinery. Craven Bros. (Manchester), Limited, are machine-tool makers and engineers.

AT THE ANNUAL MEETING of the General Cable Manufacturing Company, Limited, Mr. C. W. R. Pantlin, the chairman, said that if industry was to have a chance to compete successfully in the overseas markets and play its part in the post-war world, it was imperative that not only must E.P.T. be repealed at the earliest possible moment, but in addition some considerable relief from ordinary taxation must be granted. Otherwise industry in general would be strangled, with disastrous results to the country.

THE COUNCIL OF THE INSTITUTE OF WELDING invite competition for the award in 1945 of the Bronze Medal endowed by Sir William J. Larke, K.B.E., a past-President of the Institute. The Council have also decided, in the competition of 1945, to award a first prize of £50 to the winner of the medal, a second prize of £30, and other prizes, to be allocated at the discretion of the examiners, of a total value of £30. Full particulars are available on application to the Secretary, Institute of Welding, 2, Buckingham Palace Gardens, London, S.W.1.

PRESIDING AT THE annual meeting of the Power-Gas Corporation, Limited, Mr. Wilfred Beswick, the chairman, said that their group of companies had made important contributions to the war effort in the production of plant and equipment. In particular, they had played a substantial part as main contractors in the provision of equipment for the artificial harbours for the invasion of Europe. He anticipated that the change-over from wartime to peacetime production could be effected smoothly and without any loss of time, and was confident that they would be able to hold their own in the export markets.

OBITUARY

MR. ANDREW INGLIS, who died in a Glasgow hospital on January 20, was for many years in the shipping department of the Carron Company, Falkirk. He was 75.

MR. ROBERT WILSON, for many years outside representative of Walter MacFarlane & Company, Limited, Saracen Foundry, Possilpark, Glasgow, died on January 20, as the result of an accident.

MR. JOHN HILL, former general secretary of the Boilermakers' Society, died recently at Bingley, Yorkshire, aged 82. He retired nine years ago after 27 years in that capacity and was succeeded by the present secretary, Mr. Mark Hodgson.

DR. G. D. BENGOUGH, F.R.S., consultant to the Department of Scientific and Industrial Research, died at St. Leonard's-on-Sea on January 20. He was 68. Dr. Bengough was an outstanding authority on metals. He gained his first research experience with the late Sir William Roberts-Austin at the Royal Mint. Later he was engaged in handling gold and tin ores in Burma, after which, on returning to this country, he took up lectureships at Birmingham and Liverpool Universities. Subsequently he became investigator on corrosion to the Institute of Metals. During the last war, while serving in the Royal Artillery, he was seconded at the request of the Admiralty for research work on naval problems. He also carried out similar work for the R.A.F. On demobilisation he was appointed a Principal Scientific Officer in the Department of Scientific and Industrial Research (Chemical Research Laboratory). He was the author of numerous Papers to various bodies, notably the Royal Society.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"NYKROCOR"—Iron and steel. W. T. FLATHER, LIMITED, Tinsley, Sheffield.

"MITIA"—Machine tools. THOS. FIRTH & JOHN BROWN, LIMITED, Savile Street, Sheffield.

"NYLKUT"—Machine tools and machinery. W. T. FLATHER, LIMITED, Sheffield Road, Tinsley, Sheffield.

"FIR VIC"—Metal goods. FIRTH-VICKERS STAINLESS STEELS, LIMITED, Staybrite Works, Weedon Street, Sheffield, 9.

"CASTOLIN-EUTECTIC"—Oxy-acetylene welding rods, soldering metal, etc. EUTECTIC WELDING ALLOYS COMPANY, c/o Leslie N. Cox, 329, High Holborn, London, W.C.1.

"CARBLOX"—Refractory material for the construction and lining of furnaces, etc. THOMAS MARSHALL & COMPANY (LOXLEY), LIMITED, Storrs Bridge Works, Loxley, Sheffield, 6.

"DURFACE"—Oxy-acetylene welding rods; soldering metal in the form of bars; spelter for welding, brazing and soldering; soldering metal rods containing or incorporating flux. EUTECTIC WELDING ALLOYS COMPANY. c/o Leslie N. Cox, 329, High Holborn, London, W.C.1.

FUNDAMENTALS OF CIVILISATION

No. 3 AGRICULTURE

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With his wooden ploughshare and lumbering oxen primitive man toiled in the fields. His reward was at its best a meagre livelihood, at its worst, famine. There was never an abundance of the fruitful things of the earth.

Science and the machine magnify the individual effort and multiply the yield. Thus it is that the tractor symbolises the new era of agriculture, when no man shall toil excessively and no one should starve.

Behind these visible manifestations of knowledge and progress lie the painstaking and laborious research which has produced steels of special qualities to withstand extreme stress and of great endurance. The food of man depends on the high standard of materials produced by the metallurgists and to them man owes his existence as never before in the history of the world.

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SAMUEL FOX & CO. LTD., SHEFFIELD
UNITED STRIP & BAR MILLS, SHEFFIELD
APPLEBY-FRODINGHAM STEEL CO. LTD., SCUNTHORPE
WORKINGTON IRON & STEEL CO., WORKINGTON
THE SHEFFIELD COAL CO. LTD.
THE ROTHERVALE COLLIERIES, TREETON
UNITED COKE & CHEMICALS CO. LTD.
THOS. BUTLIN & CO., WELLINGBOROUGH

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COMPANY RESULTS

(Figures for previous year in brackets.)

Huelva Copper & Sulphur Mines—Debit balance for the year ended June 30, 1944, after charging £450 for taxation, of £1,353, reducing the balance brought in, £2,154.

J. & E. Hall—Net profit for the year ended September 30, £94,705 (£95,036), after providing £27,000 (£140,000) for E.P.T. and before charging income-tax, £50,000 (£55,000); dividend of 10% (same); forward, £81,809 (£63,104).

Steel Barrel Scammells & Associated Engineers—Net income for the year ended June 30 last, £44,479 (£44,254); profit of group, £91,432 (£80,314); final dividend of 9%, plus a bonus of 5%, making 20% (same), and an interim dividend of 6% (same) on account of the year ending June 30, 1945.

Richard Hill & Company—Trading profit for the year ended September 30, 1944, £68,153 (£31,971); depreciation, £10,093 (£10,106); taxation, £33,000 (£11,000); provision for deferred repairs, £10,000 (nil); final dividend of 3%, making 6% (same), plus a special bonus of 3% (nil); forward, £30,490 (£24,198).

Tecalemit—Profit for the year ended July 31, after providing for taxation and including dividend receivable from subsidiary company, £97,958 (£91,055); depreciation, £40,514; written off patents, licences and designs, £2,533; interim dividend of 6%, less tax, £10,283; final dividend of 12%, less tax, £25,706; forward, £43,556 (£29,634).

Ley's Foundry & Engineering—Gross dividends from subsidiaries in respect of the year to September 30, 1944, £125,750 (£85,250); total income, with interest and E.P.T. recoverable, £132,124 (£88,621); net profit, £65,371 (£43,666), after £65,415 (£43,666) for income-tax; final ordinary dividend of 5%, making 11% (same); to general reserve, £25,000 (nil); forward, £52,727 (£48,890).

R. A. Lister & Company—Trading profit for the year ended September 30, 1944, including interest and dividends, £399,221 (£399,383); depreciation, £43,029 (£43,503); employees' pension scheme, £6,576; taxation, £220,981 (£212,036); net profit, £127,735 (£136,839); preference dividend, less tax, £9,000; final ordinary dividend of 5% and a bonus of 6%, making 16% (same); to general reserve, £50,000 (£35,000); to contingencies reserve, nil (£35,790); purchase price of new businesses written off, £11,500 (nil); forward, £73,759 (£72,524).

A JOINT MEETING of the Ebbw Vale Metallurgical Society and the Iron and Steel Institute will be held in the Workman's Hall, Ebbw Vale, on February 8, at 6.30 p.m. Mr. G. A. Young, assistant general manager of Richard Thomas & Baldwins, Limited, Ebbw Vale, will take the chair, and Mr. G. D. Elliot, of the Appleby-Frodingham Steel Company, Limited, will lecture on "Blast-furnace Design, Operation and Problems." The lecturer will be introduced by Dr. C. H. Desch, F.R.S.

PERSONAL

MR. W. MCMINNIAGLE, general manager, and MR. J. W. HAIR, secretary, have been appointed to the board of directors of the Middle Docks & Engineering Company, Limited, South Shields.

MR. N. K. BUNN, works manager, and MR. J. L. HARVEY, production manager, have been appointed joint general works managers of British Insulated Cables, Limited. MR. W. J. CLEMENTS has been appointed works manager, Prescot works.

MR. A. E. CHATTIN, B.Sc., is adding the position of assistant secretary of the Institute of Metals to that of assistant secretary of the Iron and Steel Institute, whilst MR. N. B. VAUGHAN, M.Sc., will serve as assistant editor of the Iron and Steel Institute as well as for the Institute of Metals.

MR. W. W. VINSEN, manager of the Coventry works, and MR. E. S. LITTLE, head of the accounting department, have been elected directors of the British Thomson-Houston Company, Limited. Mr. Vinsen has been appointed assistant director of manufacture, and will assist Mr. G. M. Campbell, director of manufacture.

MR. GEORGE ALBERT URE, a director of Smith & Wellstood, Limited, Bonnybridge, has celebrated his jubilee as a director of the company. The first foundry to be erected in Bonnybridge was established in 1860 by Mr. George Ure, grandfather of the present director. The fusion with Smith & Wellstood, Ltd., took place in 1890.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

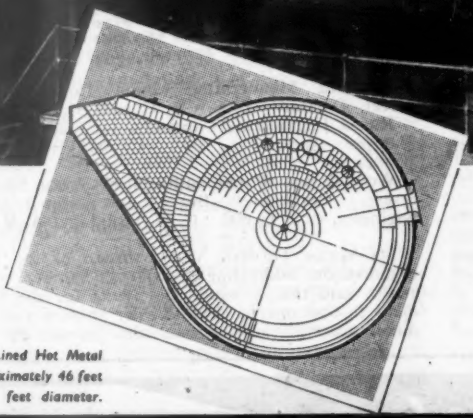
Belfast, February 7—Iron; iron castings; bolts, spikes, etc.; tyres and axles; springs, steel, and files; nails, screws, etc.; carriage fittings; fireclay goods, for 12 months from March 1, for the Belfast and County Down Railway Company. Mr. T. B. Andison, secretary, Queen's Quay Terminus, Belfast. (Fee 1s., non-returnable.)

Godalming, February 10—Supplying and laying new water mains as follows: 210 yds. of 4-in. dia. cast-iron water main and specials at Shackleford, and 530 yds. of 3-in. dia. cast-iron water main and specials at Witley, for the Corporation. Mr. C. B. Spivey, water engineer, 35, Bridge Street, Godalming. (Fee £2 2s., returnable.)

London, S.E., February 19.—Drain pipes, etc., sewer ironwork; tools, iron, etc., for the Southwark Borough Council. Mr. D. T. Griffiths, town clerk, Southwark Town Hall, Walworth Road, S.E.17.

London, W., February 9—Iron goods for 12 months from April 1, for the Kensington Borough Council. Mr. F Webster, town clerk, Town Hall, Kensington.

Oswaldtwistle, February 22—Cast-iron pipes and special castings; stop-taps and ferrules; brass fittings, etc., for 12 months from April 1, for the Urban District Council. The Surveyor, Town Hall, Oswaldtwistle.



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101

Raw Material Markets

IRON AND STEEL

Pig-iron production has been carefully regulated to correspond with the known requirements of the foundry, engineering and steel trades. Should the need arise, more furnaces can be put into blast, but in the meantime stocks of iron represent no more than a reasonable working margin, and consumers are not allowed to purchase supplies in excess of their visible needs. High-phosphorus iron seems to be fairly plentiful, but the make of low-phosphorus and refined iron is fully absorbed, and there is very little hematite available, even for approved purposes.

Weather conditions have been responsible for some irregularities in the delivery of coke, but operation of the furnaces and foundries has not been interrupted.

There has been a little more activity in the scrap trade, steelworks being more disposed to buy, but stocks generally are adequate, and there is a lack of keenness everywhere. Operations at merchants' yards have been hindered by the weather, and deliveries have been held up through the same cause. There is a steady demand for good machinery scrap, and foundries are taking up also fair quantities of ordinary heavy cast iron. Demand for light iron scrap is slow, but there is a good market for short steel scrap, for foundry use or refined pig-iron making.

It is evident that consumption of semi-finished steel at the re-rolling mills is still maintained at a high level. Suspension of imports from America has thrown upon British steelmakers the onus of providing the whole of the materials required for the finishing mills. Especially heavy is the demand for sheet bars, and works are not only pressing for maximum deliveries of prime billets, but are also taking up substantial tonnages of defectives, crops, etc.

Recession is most marked in the heavy steel trade. Producers are still receiving a fairly steady flow of orders for light and medium sections, but the turnover in heavy sizes is extremely limited. Similarly, there has been a contraction in the tonnages required by the shipbuilders. Here, again, the decline is most noticeable in regard to heavy plates, and even in the sheet trade order-books reflect the marked predominance of the lighter gauges. One of the steadiest features of the steel trade is the sustained demand for railway and colliery material, and mills engaged on this class of work are assured of regular employment for the whole of the current period.

NON-FERROUS METALS

The stepping up of war production in certain directions may result in a slower absorption of the supplies of light metal recently made available—not because there is any shortage of aluminium, magnesium, etc., but because plant which might have been making a start with the production of civilian goods will be otherwise engaged. However, there has been a fair flow of aluminium into other than war channels since the restrictions were relaxed. The war has given a great stimulus to the production of this metal, and there will undoubtedly be a great bid to extend its peacetime uses. Unless an outlet can be found for the metal now going into aircraft construction, a curtailment of output would seem to be unavoidable. Aircraft production will continue after the war, but scarcely on a scale to absorb the present large-scale production. With this in mind consumers confidently expect a reduction in aluminium prices after, if not before, the end of the war.

There is little change in the supply position of copper, spelter, tin and lead. It is easier than it was at this time last year to secure supplies. Consumption for war purposes is still on a large scale, though well below the peak, and a fair amount of metal is being absorbed in other directions.

NEW COMPANIES

(*"Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.*)

Dartford Metalcrafts, Albion Ironworks, Green Street, Dartford—£500. R. L. and H. G. Porter.

Raven Engineering Company, 11a, St. John's Road, Hampton Wick. £2,000. C. W. Osborne and S. Barnes.

Wood & Son (Portsmouth), Nobbs Lane, St. Thomas Street, Portsmouth—Brass and iron founders, engineers, etc. £4,000. C. G. Wood and W. R. Drake.

SIR MILES THOMAS, vice-chairman of the Nuffield organisation, addressing Newport Chamber of Commerce, said that it would be wrong for the Government to continue to operate their shadow factories in direct peacetime competition with pre-war enterprises.

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